Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

AMERICAN
STATISTICAL ASSOCIATION.

NEW SERIES, No. 69. MARCH, 1905.

RECENT RAILWAY ACCIDENTS IN THE UNITED STATES.*

BY CARROLL W. DOTEN.

The people of this country have recently awakened to a realizing sense of the tremendous sacrifices of human life demanded of them by their railways. Newspapers and magazines are filled with discussions and attempts at explanation. The numbers of killed and injured are compared sometimes with the casualties suffered by great armies in battle. But the mere statement of the figures is sufficiently appalling without the aid of comparisons. When one reads that, in the year 1903, 9,840—almost ten thousand—persons were killed in the United States in railway accidents of one kind or another, and that 76,553 suffered injuries of various degrees of severity from the same cause, he is staggered by the horror of it all. The figures for all accidents in 1904 are not yet available, but those contained in the last quarterly bulletin of the Interstate Commerce Commission indicate that there will be no falling off in the totals.

The explanations of these figures are numerous, and come from various sources. Railroad officials blame their men. They say that employees are reckless, and take unnecessary chances. They also declare that labor unionism is responsible for a growing laxity of discipline. On the other hand, the employees claim that they are worked over-time on long continuous runs, and that the railroads do not provide and maintain proper safety appliances. The Interstate Commerce Commission calls attention to certain defects in equipment which should be remedied. Finally, the general public is left in doubt as to the real cause of the evil, and is unable to form any definite opinion as to the remedies that ought to be applied.

---

* Read before the American Statistical Association, January 24, 1905.

Several questions naturally suggest themselves in regard to these matters:—

(1) Is the situation as bad as it seems? That is, are not these large figures simply in keeping with the growing extent of the great industry itself?

(2) What proportion of these casualties may be regarded as inevitable in the very nature of the case?

(3) How can the increase in accidents be checked, and the theoretical minimum approximately attained? That is, What remedy or remedies can be applied to lessen this evil?

The writer of this paper has thought it possible by a study of the statistics of railway accidents to throw some light upon these questions, if not to arrive at a satisfactory solution of them. It was with this purpose in view that he undertook this work. The statistical data which have been used in constructing the tables in this article are mainly derived from the various publications of the Interstate Commerce Commission, the Reports of the Board of Trade for the United Kingdom, and the Statistical Year Book of Canada of different dates. While each of these sources has its own peculiar merits and defects, the reports of the Board of Trade are by far the most complete, and leave little to be desired except in the matter of arrangement and tabulation. The statistics of the Interstate Commerce Commission have steadily improved from year to year, and have now reached a point where they supply most of the general information desired in convenient form for use. Their most serious defect, however, is that they are too general in their nature. This is due, of course, to the fact that results are published rather than the detailed information upon which those results are based. The strength of the English reports coincides with the weakness of those of the Interstate Commerce Commission. It would seem that the latter might be improved in this matter, while still retaining their present excellent features. The tabulation by groups* is good so far as it goes; but the group covers too wide an area and includes too great a diversity of local, physical, financial, and commercial conditions. Tabulation by railway systems probably would not be feasible under the conditions existing in this country; but if States were used as a basis in this matter of railway accidents, the statistics would be of much greater value for practical purposes than they are at present.

The methods of tabulation have been chosen in every case in order to get at the truth rather than, as is too often the case, for the purpose of emphasizing a special tendency. It is possible to exaggerate the dangers of railroading in this country as compared with those where the traffic is of much greater density and where the roads are consequently better constructed and guarded. It is just as easy, on the other hand, to belittle the evil by adopting a different basis of comparison. The result is that the public cannot trust either the rabid assailants of privately owned and managed

---

*The groups here referred to and made use of in other parts of this article are those ten geographical divisions of the United States which the Interstate Commerce Commission adopted in 1890 for statistical purposes. The principal reasons for the assignment of railway statistics to territorial groups, as set forth by the Commission, are as follows: "The chief service of statistics is to disclose what is typical respecting the facts investigated, but, in order to obtain a type of which practical use may be made, it is necessary that the data compiled should be fairly congruous in character. . . . The most simple principle of classification for the present investigation is the one which divides railways according to the territory through which they run, since in this manner density of population, the topography of the country, and the character of the industries served by the railways may be taken into account. It was endeavored to grant each of these elements its due consideration."—*Statistics of Railways*, 1890, p. 10.

railroads or the railroad officials who adopt fallacious methods of comparison.*

The following table has been taken bodily from the Interstate Commerce Commission's *Statistics of Railways* for the year ending June 30, 1903. This table seems to indicate a very bad state of affairs. The total of injured has increased practically 200 per cent. since 1888, and the total of killed about 90 per cent.; while a tendency toward great improvement after 1893 has been replaced by one of retrograde character, significant in its proportions, since 1898. These changes will appear somewhat less striking, however, when brought into relation with the figures representing the extension of the railway system and the growth of traffic during the same period.

TABLE I.

COMPARATIVE SUMMARY OF RAILWAY ACCIDENTS (1888–1903).

Year.	Employees.		Passengers.		Other Persons.		Total.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
1888 . .	2,070	20,148	315	2,138	2,897	3,602	5,282	25,888
1889 . .	1,972	20,028	310	2,146	3,541	4,135	5,823	26,309
1890 . .	2,451	23,396	286	2,425	3,598	4,206	6,335	29,027
1891 . .	2,660	26,140	293	2,972	4,076	4,769	7,029	33,881
1892 . .	2,554	28,267	376	3,227	4,217	5,158	7,147	36,652
1893 . .	2,727	31,729	299	3,229	4,320	5,435	7,346	40,393
1894 . .	1,823	23,422	423	3,034	4,300	5,433	6,447	31,889
1895 . .	1,811	25,696	170	2,375	4,155	5,677	6,136	33,748
1896 . .	1,861	29,969	181	2,873	4,406	5,845	6,448	38,687
1897 . .	1,693	27,667	222	2,795	4,522	6,269	6,437	36,731
1898 . .	1,958	31,761	221	2,945	4,680	6,176	6,859	40,882
1899 . .	2,210	34,923	239	3,442	4,674	6,255	7,123	44,620
1900 . .	2,550	39,643	249	4,128	5,066	6,549	7,865	50,320
1901 . .	2,675	41,142	282	4,988	5,498	7,209	8,455	53,339
1902 . .	2,969	50,524	345	6,683	5,274	7,455	8,588	64,662
1903 . .	3,606	60,481	355	8,231	5,879	7,841	9,840	76,553

---

* To illustrate reasoning of this sort it is only necessary to refer to a recent article in which the author argues that railroading in the United Kingdom is more dangerous to life and limb than in the United States. He does this by taking length of line as a basis in one instance and passenger-miles in another, without telling his readers that the passenger density per mile of line (exclusive of season ticket-holders) is over

Figures for 1904 comparable with those above are not available; but the following table, based on *Accident Bulletin* No. 12, issued by the Commission, brings the statistics of certain classes of casualties down to June 30, 1904. These bulletins have been issued quarterly during the past three years under a special act of Congress, approved March 3, 1901. They contain statistics of all accidents to passengers and to employees while on duty, due to the movement of trains. No figures are given in regard to "Other Persons," and those concerning employees and passengers are manifestly not strictly comparable with those contained in the yearly statistics.

TABLE II.

ALL ACCIDENTS REPORTED IN QUARTERLY BULLETINS.

Year.	Employees.		Passengers.		Total.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
1902	2,516	33,711	303	6,084	2,819	39,800
1903	3,233	39,004	321	6,973	3,554	45,977
1904	3,367	43,266	420	8,077	3,787	51,343

If the increase here indicated holds true of all classes of accidents, the totals for the year 1904, when they appear, will be still more startling than those for the year previous. It is possible, however, that a small part of this increase is due to more perfect reports.

Of the three classes under which casualties are tabulated the one entitled "Other Persons" is especially striking because of the large total number of killed. Not much has been attempted in regard to this class of accidents because of the meager data available. It is worth noting, however, that, of the 5,879 killed in 1903, 5,000 were reported as being tres-

---

fifteen times as great in the United Kingdom as it is in the United States (inclusive of season ticket-holders), and that there are no reliable passenger-mile or ton-mile statistics available respecting the British railways.

passers. There is no doubt that a majority of such accidents are due to the carelessness of those who make a highway of the railway companies' tracks. This is apparent from the following table:—

TABLE III. ACCIDENTS TO OTHER PERSONS.

Rate per Million Train-miles and per Thousand Miles of Line.

Year.	At Highway Crossings.		At Stations.		All Causes.			
	Killed per Million Train-miles.	Injured per Million Train-miles.	Killed per Million Train-miles.	Injured per Million Train-miles.	Killed per Million Train-miles.	Injured per Million Train-miles.	Killed per Thousand Miles of Line.	Injured per Thousand Miles of Line
1889 . .	0.6	1.0	0.5	0.7	5.4	6.3	23.1	27.0
1890 . .	0.6	0.9	0.5	0.7	5.0	5.8	23.0	26.9
1891 . .	0.7	1.1	0.5	0.8	5.4	6.3	25.3	29.6
1892 . .	0.7	1.2	0.5	0.6	5.3	6.4	26.0	31.8
1893 . .	0.7	1.2	0.5	0.7	5.1	6.5	25.5	32.0
1894 . .	0.7	1.0	0.4	0.7	5.6	7.0	24.5	30.9
1895 . .	0.7	1.2	0.5	0.9	5.4	7.4	23.4	31.9
1896 . .	0.8	1.3	0.4	0.8	5.4	7.2	24.2	32.1
1897 . .	0.7	1.3	0.4	0.6	5.7	7.8	24.7	34.2
1898 . .	0.8	1.3	0.4	0.7	5.5	7.3	25.3	33.5
1899 . .	0.8	1.2	0.4	0.7	5.4	7.2	24.9	33.3
1900 . .	0.8	1.5	0.4	0.7	5.7	7.4	26.2	33.9
1901 . .	0.9	1.5	0.4	0.6	6.1	7.9	28.0	36.8
1902 . .	0.9	1.4	0.4	0.5	5.6	8.0	26.3	37.2
1903 . .	0.9	1.5	0.4	0.5	5.9	7.8	28.6	38.2

It will be observed that this class of accidents shows an increase when reduced to a train-mile basis, but it is not so marked as indicated by the actual figures in Table I. The same tendency appears when the basis of comparison is the length of line. There has been something of an improvement in the matter of accidents at stations, but the fatal grade crossing is still claiming its full quota of victims. In fact, this class of accidents has been increasing in recent years, showing that progress in the abolishment or better protection of such crossings has not kept pace with the growth of population subject to their dangers. But it is rather surprising to see how small a proportion these accidents constitute of the total number to this class of persons. The most common cause of accidents is the practice of walking on the track. In 1903, 55 per cent. of deaths and 25 per cent. of injuries were accounted for in this way. This class of accidents will continue to increase so long as people make a highway of the railroads of the country. The railroad officials can do something to put a stop to this practice, but for the most part they are powerless to guard their right of way against trespassers. It is practically impossible to protect people from the consequences of their own folly, and about all that can be said is that railroads simply add to the number of death-traps that lie in the pathway of the unwary.

When accidents to employees and passengers are considered, the case assumes an entirely different aspect. Here are two great classes of persons who have a right to be on railroad property and whose business compels them to subject themselves to the dangers incident to railway traffic and travel. How best to protect these persons should be the constant study of the railway manager, and success along this line should be the real test of efficient management.

It will be noticed, by referring to Table I, that there was an increase in the numbers of both killed and injured among passengers down to 1893. Then there was a sharp decline in the casualty lists for several years, followed by a rather rapid rise after 1899, which has continued to the present time. These same tendencies are disclosed, though not so conspicuously, when accidents are related to amount of traffic as represented by train-miles and number of passengers carried. The following table treats of accidents to passengers in four different ways:—

TABLE IV.

RAILWAY ACCIDENTS IN THE UNITED STATES.

Rates Based on Number of Passengers, Passenger-miles, and Train-miles.

Year.	Passengers.							
	1 Killed per Million Carried.	2 Killed per Million Passenger-miles.	3 Killed per Million Passenger Train-miles.	4 Killed per Million Total Train-miles.	1 Injured per Million Carried.	2 Injured per Million Passenger-miles.	3 Injured per Million Passenger Train-miles.	4 Injured per Million Total Train-miles.
1889 .	0.63	.026	1.11	0.47	4.34	0.18	7.74	3.25
1890 .	0.55	.023	1.00	0.40	4.66	0.19	8.50	3.36
1891 .	0.53	.022	0.95	0.39	5.34	0.22	9.65	3.94
1892 .	0.66	.028	1.18	0.47	5.61	0.24	10.14	4.01
1893 .	0.50	.020	0.89	0.35	5.40	0.22	9.60	3.83
1894 .	0.57	.024	0.99	0.42	5.33	0.22	9.30	3.92
1895 .	0.32	.013	0.53	0.22	4.48	0.19	7.49	3.10
1896 .	0.34	.014	0.54	0.22	5.36	0.22	8.65	3.53
1897 .	0.44	.018	0.66	0.28	5.54	0.22	8.34	3.31
1898 .	0.43	.016	0.64	0.26	5.73	0.22	8.63	3.48
1899 .	0.45	.016	0.67	0.28	6.41	0.23	9.72	3.99
1900 .	0.43	.015	0.68	0.28	7.07	0.25	11.37	4.65
1901 .	0.47	.016	0.74	0.31	8.31	0.28	13.08	5.49
1902 .	0.53	.018	0.85	0.37	10.20	0.34	16.05	7.13
1903 .	0.51	.017	0.84	0.36	11.83	0.39	19.37	8.23

This table does not make a very bad showing for the railroads in the matter of fatal accidents, but the rate is extremely high in regard to the injured. The excessive increase in the number of injured may be due in a slight degree, as railroad men claim, to more complete returns of trivial injuries in recent years; but improvements in emergency brakes, in car construction, and in methods of heating cars, probably account in large measure for the lessening proportion of fatalities. An inspection of the casualties due to collisions will show that this theory has some basis in fact. The average numbers of passengers killed and injured in collisions during the four years ending in 1894 were 99 and 738, respectively, and those for the four years ending 1904 were 119 and 2,544. Reduced to the form of ratios, the killed to injured are approximately as 1 to 7 in the former and 1 to 21 in the latter period.* If this theory is true, it shows that the railroads have made very much greater progress in the matter of guarding against the consequences of mistakes than in the elimination of the mistakes themselves.

This unenviable record of the railroads of the United States in the matter of injuries inflicted on passengers is well brought out in the following table. This country enjoys the bad pre-eminence of first place in this respect, and yields an undesirable precedence to only five countries (Russia, Spain, New Zealand, Canada, and Egypt) in the rate of fatalities to passengers. The accident rate in the United States is apparently about 7½ times as great as that in the United Kingdom. This difference would be still greater if there were included in the number of passengers in the latter country those who hold season tickets. In 1903 about 1,200,000,000 passenger trips were reported to the Board of Trade. Besides these there were nearly 2,000,000 season ticket-holders whose rides would increase this number about 50 per cent. if we count only six trips a week for each ticket-holder.

---

* The actual numbers of passengers killed and injured in collisions during these two periods were as follows: —

	Killed.	Injured.		Killed.	Injured.
1891	59	623	1901	55	1,458
1892	136	783	1902	133	2,360
1893	68	772	1903	123	2,975
1894	132	767	1904	166	3,383

The above figures, except those for 1904, are derived from the *Statistics of Railways.* Those for 1904 are from *Quarterly Bulletin* No. 12 and are doubtless somewhat smaller than the final figures which will appear in the *Statistics* for that year when it is published. For the year 1903 the discrepancy was 5 in the number of killed, and 84 in the number of injured. The totals were: *Statistics of Railways*, 123 killed and 2,975 injured; *Quarterly Bulletin* No. 8, 118 killed and 2,891 injured. This difference is due to the fact that more nearly complete returns are available in the case of the *Statistics*, which is published at least a year later than the *Accident Bulletin.*

TABLE V.

ACCIDENTS TO RAILWAY PASSENGERS IN CERTAIN COUNTRIES.*

Country.	Year.	Passengers.			
		Number Killed.	Number Injured.	Killed per Million Carried.	Injured per Million Carried.
Austria	1901	11	232	0.07	1.37
Hungary	1901	14	60	0.21	0.89
Belgium	1901	7	195	0.05	1.39
France	1901	7	345	0.02	0.82
German Empire	1900	67	317	0.08	0.39
Bavaria	1900	10	70	0.15	1.04
Baden	1900	11	212	0.31	6.02
Würtemberg	1900	2	10	0.06	0.30
Holland	1901	4	24	0.13	0.71
Italy	—	7	141	0.14	2.77
Portugal	1901	2	16	0.45	3.62
Russia in Europe	1900	90	549	0.88	5.40
Spain	1896	19	61	0.63	2.03
Sweden	1901	1	6	0.09	0.54
Switzerland	1901	6	50	0.10	0.82
New South Wales	1901–02	2	40	0.07	1.30
Victoria	1901–02	4	355	0.07	6.14
South Australia	1901–02	—	2	0.00	0.21
New Zealand	1901–02	6	17	0.81	0.31
Canada	1903	53	258	2.39	11.65
Japan	1902	30	185	0.37	2.26
Norway	1902	2	2	0.19	0.19
United States	1903	355	8,231	0.51	11.83
Egypt	1901	35	65	2.73	5.07
United Kingdom	1902	129	2,546	0.07	1.43

The following table affords an opportunity to compare the records of the United Kingdom, Group II, the United States as a whole, and Canada, in respect to passenger casualties. The basis of comparison gives something of an advantage to the railroads of the United Kingdom, owing to the shorter journeys taken in that country; but this is in part offset by the fact that season ticket-holders are not included in the number of passengers carried by the British roads. Group II (trunk-line territory east of Buffalo) is used in this connection and in some following comparisons, not because it is typical of American conditions, but because it most closely resembles the United Kingdom in length of lines, double track, density of traffic, and, in fact, everything except equipment and methods of management, which, of course, are typically American.

---

* Statistical Year Book of Canada, 1903.

TABLE VI. ALL ACCIDENTS TO PASSENGERS.

Rates per Million Passengers Carried.

Year.	United Kingdom.		Group II.		United States.		Canada.	
	Killed per Million Carried.	Injured per Million Carried.	Killed per Million Carried.	Injured per Million Carried.	Killed per Million Carried.	Injured per Million Carried.	Killed per Million Carried.	Injured per Million Carried.
1891 . .	0.15	1.8	0.29	2.7	0.53	5.3	0.98	8.1
1892 . .	0.16	2.6	0.47	4.2	0.66	5.6	1.03	2.9
1893 . .	0.13	1.8	0.46	4.6	0.50	5.4	0.81	3.9
1894 . .	0.13	1.6	0.39	4.5	0.60	5.3	0.83	4.3
1895 . .	0.09	1.5	0.20	4.0	0.32	4.5	0.64	4.6
1896 . .	0.10	2.1	0.22	4.8	0.34	5.4	0.74	3.9
1897 . .	0.12	2.1	0.14	3.3	0.44	5.5	0.43	4.8
1898 . .	0.15	2.2	0.24	3.9	0.43	5.7	0.27	4.9
1899 . .	0.15	2.5	0.37	5.1	0.44	6.4	1.05	8.1
1900 . .	0.13	2.7	0.17	4.7	0.43	7.1	0.33	7.7
1901 . .	0.14	2.4	0.32	7.0	0.47	8.3	0.98	7.5
1902 . .	0.12	2.7	0.26	8.7	0.53	10.2	0.92	8.4
1903 . .	0.13	2.9	0.33	8.1	0.51	11.8	2.39	11.7

Canada has a worse record than the United States in the matter of fatalities; but it should be remembered that the conditions in Canada are more primitive than in most parts of this country, and, moreover, that the Canadian roads have been constructed and managed by American enterprise and according to American models. A part of the superiority of Group II is due to the shorter average passenger journey, which in 1903 was 21.41 miles against 30.10 miles for the whole country. While this table does not indicate so great an inferiority to the United Kingdom as is sometimes claimed to exist by the critics of American methods, still there is one feature which is of great significance, and which seems to indicate that something is radically wrong on this side of the Atlantic. This is the tendency of accidents to the increase with an increase of traffic and at a more rapid rate. The rate in the United Kingdom fluctuates somewhat; but there has been no such marked tendency to increase as is manifested in this country, particularly during the past four or five years. This same tendency will be brought out more strikingly in some of the subsequent tables.

A better test of the real safety of travel is a comparison of train accidents, in which the passenger's carelessness plays no part. This is the purpose of the following table, in which train accidents are reduced to a train-mile basis. This method of comparison gives a slight advantage to this country, owing to the fact that a much larger proportion of our train-mileage is made up of freight traffic, which is manifestly less dangerous to passengers than is the service directly concerned with their conveyance. The ratio of freight train-miles to passenger train-miles is approximately 5 to 4 in the United States, while it is only 3 to 4 in the United Kingdom.

TABLE VII. TRAIN ACCIDENTS TO PASSENGERS.

Rates per Million Total Train-miles.

Year.	United Kingdom.		Group II.		United States.	
	Killed per Million Train-miles.	Injured per Million Train-miles.	Killed per Million Train-miles.	Injured per Million Train-miles.	Killed per Million Train-miles.	Injured per Million Train-miles.
1891	0.01	2.7	0.13	0.9	0.15	2.0
1892	0.06	1.8	0.30	1.7	0.24	2.0
1893	0.05	1.5	0.14	1.9	0.12	2.0
1894	0.05	1.0	0.22	2.3	0.21	2.0
1895	0.01	1.2	0.03	1.0	0.04	1.1
1896	0.01	1.1	0.06	1.2	0.05	1.6
1897	0.05	0.9	0.01	0.9	0.12	1.4
1898	0.07	1.7	0.09	0.6	0.09	1.5
1899	0.04	1.7	0.23	1.7	0.10	1.9
1900	0.04	2.1	0.07	1.6	0.10	2.3
1901	0.00	1.2	0.17	3.5	0.12	2.6
1902	0.01	1.8	0.15	4.8	0.18	3.8
1903	0.06	2.0	0.13	4.1	0.18	4.7

Calculated on the basis used in the above table, the average rate of fatalities for the thirteen years is 0.035 per million train-miles in the United Kingdom and 0.123, or nearly four times as great, in the United States. The average rates in the two countries for the last four years are 0.028 and 0.145 respectively, or over five times as great for the United States. On the whole, the showing in regard to non-fatal accidents does not appear so bad for the United States, though the average rate during the past four years has been about twice as great as it was in the United Kingdom.

A different basis of comparison is used in the following table. It brings out the same tendencies as are shown in the preceding table, but it changes the relative rates somewhat to the advantage of Group II and the United Kingdom as compared with the United States. The train-mile basis is unfair to the railways of the United Kingdom, as explained above, and the number of passengers carried is an unfair basis of comparison for the American railways, because of the much longer passenger journeys in this country. The truth of the matter lies somewhere between the results afforded by these two methods, but just where one cannot say, since passenger-mile statistics are not available.

TABLE VIII. TRAIN ACCIDENTS TO PASSENGERS.

Rates per Million Passengers Carried.

Year.	United Kingdom.		Group II.		United States.	
	Killed per Million Carried.	Injured per Million Carried.	Killed per Million Carried.	Injured per Million Carried.	Killed per Million Carried.	Injured per Million Carried.
1891	0.01	1.0	0.12	0.8	0.20	2.7
1892	0.02	0.7	0.29	1.5	0.34	2.9
1893	0.02	0.6	0.13	1.7	0.17	2.9
1894	0.02	0.4	0.21	2.2	0.28	2.7
1895	0.01	0.4	0.03	1.0	0.06	1.6
1896	0.01	0.4	0.06	1.4	0.08	2.4
1897	0.02	0.3	0.01	0.9	0.19	2.3
1898	0.02	0.6	0.10	0.6	0.14	2.5
1899	0.01	0.6	0.25	1.8	0.16	3.1
1900	0.01	0.8	0.07	1.6	0.16	3.4
1901	0.00	0.4	0.15	3.1	0.18	3.9
1902	0.01	0.6	0.12	4.1	0.26	5.4
1903	0.02	0.6	0.10	3.3	0.25	6.7

The figures in these tables show a considerable degree of fluctuation from year to year, but in spite of this a general tendency can be noted. Conditions have remained practically constant in the United Kingdom, and the accident rate has not increased with the increasing volume of business. In this country, however, there was a falling off in the rate with a decrease in traffic after 1893, and a decided growth in the rate with the increase in traffic after 1898. Group II can boast a but little better record than the country as a whole in this matter of train accidents. These figures tend to show that there is room for improvement in the United States before the theoretical minimum of inevitable casualties is reached, even if we accept the United Kingdom as the exemplar of such an ideal. That country certainly afforded a remarkable illustration of the safety of railway travel in its record for the year 1901. In round numbers 1,172 million passengers (exclusive of 1,879,136 season ticket holders) were carried that year without a single fatality due to causes over which the passengers had no control.

The real perils of railroading, however, are experienced by the employees rather than the passengers. As a matter of fact, travelling by train on modern railways is probably about as safe as any ordinary vocation, while working on the railroad is one of the most dangerous occupations in modern industrial life. A glance at Table I will show how great the mortality is among railway employees. The number of deaths is ten times as great as that among passengers, while the number of injured constitutes four-fifths of the total for all classes of persons.

The tendency to an increase in casualties is especially conspicuous since 1897. The absolute amount of this increase between 1897 and 1903 was 113 per cent. in killed and 118 per cent. in injured. But, as the total number of

TABLE IX. ALL ACCIDENTS TO RAILROAD EMPLOYEES.

Rates per Thousand Employed.

Year.	United Kingdom.		United States.	
	Killed per Thousand Employed.*	Injured per Thousand Employed.*	Killed per Thousand Employed.	Injured per Thousand Employed.
1889	1.1	7.2	2.8	28.6
1890	1.3	8.2	3.3	30.3
1891	1.4	8.3	3.4	33.3
1892	1.4	7.7	3.1	34.5
1893	1.2	6.9	3.1	41.7
1894	1.3	7.1	2.3	30.3
1895	1.0	5.7	2.3	32.3
1896	1.0	8.5	2.3	35.7
1897	1.1	8.8	2.1	33.3
1898	0.9	7.7	2.2	37.0
1899	1.0	8.7	2.4	37.0
1900	1.1	8.6	2.5	38.5
1901	0.9	7.4	2.5	38.5
1902	0.8	6.6	2.5	45.4
1903	0.7	6.5	2.7	45.4

* Actual number known only in 1889, 1895, 1898, and 1901.

employees increased from 823,476 to 1,312,567, or approximately 60 per cent., during the same period, the startling character of this increase is somewhat lessened. Still, the record is bad enough, and indicates progress in the wrong direction.

The above table shows that the rate of killed in relation to total number employed is two or three times as high in the United States as it is in the United Kingdom, while the rate of injured is from three to five times as high. It is apparent that conditions in Great Britain are improving, and that railroad work is becoming less dangerous. This tendency in the case of injuries is obscured somewhat by the effects of a rule of the British Board of Trade passed in 1896, compelling railroads to report as injured men who are unable to work five hours on one of the three days following the accident. Before that time only severe injuries were reported.

In the following table, train accidents to employees are compared on the basis of train-mileage. The large proportion of freight train-mileage in this country, and the longer trains used here, requiring a larger number of trainmen, probably account in part for the very bad showing of this country in this matter. No figures are published by the Interstate Commerce Commission which would enable one to ascertain just how much more dangerous to trainmen freight traffic is; but the Board of Trade reports statistics for "goods guards," and "passenger guards" separately, and an examination of these figures shows that the average rate of casualties is about three and one-half times as great among the former as it is among the latter.

TABLE X. TRAIN ACCIDENTS TO EMPLOYEES.

Rates per Million Total Train-miles.

Year.	United Kingdom.		Group II.		United States.	
	Killed per Million Train-miles.	Injured per Million Train-miles.	Killed per Million Train-miles.	Injured per Million Train-miles.	Killed per Million Train-miles.	Injured per Million Train-miles.
1891	0.04	0.5	0.70	3.2	0.75	3.7
1892	0.03	0.3	0.58	3.2	0.64	3.5
1893	0.03	0.2	0.69	3.9	0.62	3.6
1894	0.02	0.2	0.34	2.3	0.44	2.6
1895	0.04	0.2	0.38	2.9	0.40	2.8
1896	0.01	0.4*	0.46	2.6	0.43	2.7
1897	0.02	0.4	0.29	2.6	0.44	2.6
1898	0.04	0.3	0.27	2.3	0.43	2.7
1899	0.05	0.5	0.37	2.8	0.44	3.2
1900	0.06	0.4	0.52	3.3	0.61	3.7
1901	0.02	0.4	0.73	4.2	0.65	4.2
1902	0.01	0.2	0.77	5.3	0.72	5.1
1903	0.02	0.3	1.00	3.4	0.86	6.2

Attention is called to the marked tendency to an increase in the rate of casualties among employees during the past five or six years, which is apparently much greater than that observed in the case of passenger accidents; but the larger train crews now being employed render the train-mile basis of comparison somewhat deceptive. The increase in the size of train crews between 1898 and 1903 was approximately 25 per cent. for all kinds of traffic. There are no statistics to show how much larger freight-train crews are, but no doubt the rate of increase has been even greater in that branch of the service.

A much better test of the dangers encountered by railway employees is obtained by leaving out of account shopmen, freight handlers, and office help, whose risks are not necessarily greater than those to which men are subjected who labor in ordinary machine shops and warehouses. Included in the preceding table are a considerable number of casualties under the head of train accidents which were inflicted on employees other than those concerned with the operation of trains. In the following table, accidents to trainmen alone are considered. They, of all classes of laborers, are, of course, most directly exposed to the dangers of railroading; and the extreme hazard of their vocation will be appreciated when it is observed that the ratio of killed to employed is 1 to 125, and of injured 1 to 10.

---

* New rule in regard to reporting injuries.

Table XI shows that the death-rate among trainmen in the United States is practically five times as great per thousand employed and six times as great per million train-miles as it is in the United Kingdom. The difference in rate of injured is almost as great. Another important feat-

TABLE XI. ACCIDENTS TO TRAINMEN.

Rates per Million Train-miles and per Thousand Employed.

Year.	United Kingdom.				United States.			
	Killed per Thousand Employed.*	Injured per Thousand Employed.*	Killed per Million Train-miles.	Injured per Million Train-miles.	Killed per Thousand Employed.	Injured per Thousand Employed.	Killed per Million Train-miles.	Injured per Million Train-miles.
1889 . . .	2.4	26.5	0.34	3.8	8.5	81.7	1.78	17.1
1890 . . .	2.0	31.1	0.28	4.4	9.5	85.9	2.02	18.2
1891 . . .	2.8	31.2	0.39	4.3	9.6	96.2	2.03	23.6
1892 . . .	2.2	27.1	0.32	4.0	8.9	97.5	1.87	20.5
1893 . . .	1.6	23.6	0.25	3.7	8.7	105.0	1.85	22.3
1894 . . .	1.8	22.1	0.30	3.6	6.4	81.8	1.33	16.9
1895 . . .	1.6	20.4	0.26	3.1	6.4	93.5	1.32	19.2
1896 . . .	1.2	28.9	0.19	4.9	6.6	97.8	1.32	19.6
1897 . . .	1.5	27.7	0.25	4.7	6.0	85.4	1.22	17.2
1898 . . .	1.5	27.2	0.26	4.7	6.7	91.7	1.33	18.5
1899 . . .	1.5	28.6	0.26	4.9	6.5	93.1	1.33	19.3
1900 . . .	1.8	28.1	0.31	4.9	7.3	91.9	1.57	19.8
1901 . . .	1.4	24.7	0.25	4.5	7.4	79.9	1.67	18.4
1902 . . .	1.2	22.5	0.22	4.2	7.4	95.3	1.78	22.9
1903 . . .	0.9	20.6	0.18	4.1	8.0	97.0	2.02	24.6

---

* Actual number known only in 1889, 1895, 1898, and 1901.

ure is the fact that the death-rate in the United Kingdom has been gradually declining during the whole period, while in this country the falling off after 1893 has been succeeded by a steadily rising rate. This table also illustrates the point mentioned above in connection with the use of the train-mile basis of comparison. For example, the death-rate per thousand employed increased only 33 per cent. between 1897 and 1903, whereas the rate per million train-miles increased 66 per cent.

An inquiry into the different classes of accidents to which trainmen are especially liable indicates that some are becoming less dangerous, while others show a decided increase in casualties. In Table XII accidents to employees due to coupling and uncoupling cars are considered. The total number of equipment (cars and locomotives) is taken as a basis of comparison, for two reasons. In the first place, an unknown number of other employees are occasionally engaged in this work, and suffer injuries from it. It is quite impossible to estimate accurately the number employed, when the returns show that crossing tenders, shop-men, station agents, and others are injured in this way. In the second place, it is desirable to show how the decreasing danger of this line of work has kept pace with the progress in the adoption of safety appliances. This is clearly shown in the following table, where no break occurs in the improvement in the casuality list until 1903, when a slight retrograde tendency discloses itself:—

TABLE XII.

ACCIDENTS TO EMPLOYEES.—COUPLING AND UNCOUPLING.

Rates per Million Total Equipment (Cars and Locomotives).

Year.	Total Equipment. Millions.	Equipped with Automatic Couplers. Millions.	Number Killed.	Number Injured.	Killed per Million Equipment.	Injured per Million Equipment.
1889	1.1	0.08	300	6,757	273	6,143
1890[*]	1.2	0.12	369	7,842	308	6,535
1891	1.2	0.17	415	9,431	346	7,859
1892	1.2	0.24	378	10,319	315	8,599
1893[†]	1.3	0.32	433	11,277	333	8,675
1894	1.3	0.36	251	7,240	193	5,569
1895	1.3	0.41	291	8,137	223	6,260
1896	1.3	0.55	229	8,457	176	6,505
1897[‡]	1.3	0.68	214	6,283	165	4,833
1898	1.4	0.91	279	6,988	199	4,992
1899[§]	1.4	1.14	260	6,765	185	4,832
1900	1.5	1.40	282	5,229	188	3,486
1901	1.6	1.55	198	2,768	124	1,730
1902	1.7	1.65	167	2,864	98	1,682
1903	1.8	1.77	281	3,551	156	1,973

The improvement in the matter of both fatalities and injuries in this extremely dangerous kind of work is especially noticeable in the above table. One striking thing about this improvement is that it has gone on unchecked by the growing volume of business and in spite of the large increase in the number of men employed. It is well to take note of this last point, since railroad officials are inclined to lay great stress on the fact that they have been compelled to employ so many inexperienced men in recent years. The facts disclosed in this table would seem to prove, beyond all question, that it is possible by adopting proper mechanical devices to eliminate to a large extent the personal equation in matters of this kind.

---

[*] Agitation for legislation by Congress actively begun at Convention of Railroad Commissioners, 1890.

[†] Safety Appliances Act passed by Congress, March 2, 1893. Was to go into full effect January 1, 1898.

[‡] Time extended in December, 1897, to January 1, 1900.

[§] Time again extended to August 1, 1900.

Attention is again called to the considerable increase in number of accidents in 1903 over 1902. The figures given in *Accident Bulletin* No. 12, for the year 1904, though incomplete, show that this tendency was not a mere fluctuation for the year in question. The figures for three years follow:—

TABLE XIII.

ACCIDENTS TO EMPLOYEES.—COUPLING AND UNCOUPLING.

	1902.		1903.		1904.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.
Coupling Accidents .	143	2,113	253	2,788	278	3,441

The significance of this table is emphasized by considering in this connection the following record of the car inspection service, which is under the direction of the Interstate Commerce Commission:—

TABLE XIV. CAR INSPECTION.

Summary of Work of Car Inspection Service of Interstate Commerce Commission.

Year.	Number Inspectors.	Number Cars Inspected.	Number Defective Cars.	Number Defects Reported.	Per Cent. Defective Cars to Number Inspected.	Per Cent. Defects to Cars Inspected.
1901	6	98,624	19,462	24,237	19.73	24.58
1902	10	161,371	42,718	55,032	26.47	34.10
1903	15	220,140	60,083	82,832	27.29	37.62
1904* . . .	—	208,177	65,183	—	31.31	

After examining the above table, one is forced to conclude that railroads are more inclined to observe the letter than the spirit of the law. The failure to keep safety appliances in good order points in the same direction as the extreme reluctance with which they were adopted under pressure of public authority, and seems to prove what nearly every one outside of pro-railroad circles has always believed; namely, that, left to their own initiative, the railroads of the country would have clung to old methods and devices many years longer. Great credit is due to the Interstate Commerce Commission for their efforts in educating Congress and the public in this matter, and for the effective manner in which the Safety Appliances Act, of which they were the real authors, has been administered by them.

---

* Figures taken from press report recently issued by Interstate Commerce Commission.

In the following table the effects of safety appliances of another kind are shown. Of course, the protection of trainmen was only one of the considerations which led to the enforced adoption of a continuous train-brake under the control of the engineer. If this were the only object in view, the Safety Appliances Act, so far as this matter is concerned, would have to be regarded as a practical failure, judged by the results disclosed in Table XV. It must be said, however, that the beneficial effects which might be expected to follow from the use of train-brakes have been largely nullified by the rules of the railway service which require trainmen to ride on top of the cars a great deal, even though they are not needed for braking purposes except during switching movements. Moreover, the air-brake itself is in one respect a source of danger to the men, since the retaining valve which must be used on all long grades is worked from the top of the cars. It may be impossible to remedy these evils, but every effort should be made to lessen the growing number of casualties due to such causes.

TABLE XV.

ACCIDENTS TO EMPLOYEES.—FALLING FROM CARS AND LOCOMOTIVES.

Year.	Total Equipment. Millions.	Equipped with Train-brakes. Millions.	Number Killed.	Number Injured.	Killed per Million Equipment.	Injured per Million Equipment.
1889	1.1	0.13	493	2,011	448	1,828
1890* . . .	1.2	0.15	561	2,363	468	1,886
1891	1.2	0.19	598	3,191	498	2,668
1892	1.2	0.26	611	3,244	509	2,687
1893† . . .	1.3	0.30	644	3,780	495	2,908
1894	1.3	0.33	439	2,869	338	2,207
1895	1.3	0.36	452	3,297	351	2,690
1896	1.3	0.45	472	3,898	363	2,999
1897‡ . . .	1.3	0.53	408	3,627	315	2,790
1898	1.4	0.64	473	3,859	338	2,756
1899§ . . .	1.4	0.81	459	3,970	328	2,836
1900	1.5	1.01	529	4,425	253	2,950
1901	1.6	1.16	599	6,371	374	3,982
1902	1.7	1.31	631	8,003	371	4,708
1903	1.8	1.46	749	9,108	416	5,060

The following table shows that, in spite of the much advertised improvements in road-bed and equipment made by the railroads of the country during the past few years, the casualty rate due to derailments has increased practically 120 per cent. since 1897. The rates for the different groups are subject to considerable fluctuations, owing to the smaller numbers involved, but with the exception of Group I (New England) they all illustrate this same tendency. Group IV (South Atlantic States) has the worst record in this matter, the increase between 1897 and 1903 being almost 400 per cent.

Some allowance may be made on account of the increased size of trains and the enforced use of worn-out equipment by reason of the great growth of traffic during these years;

---

* Agitation for legislation by Congress actively begun at Convention of Railroad Commissioners, 1890.

† Safety Appliances Act passed by Congress, March 2, 1893. Was to go into full effect January 1, 1898.

‡ Time extended in December, 1897, to January 1, 1900.

§ Time again extended to August 1, 1900.

but the former simply reduces the real rate of increase slightly, while the latter excuse is an evidence of poor judgment and unnecessary or misapplied economy on the part of railroad managers. The public cannot help feeling that measures of economy which render railway travel more dangerous are hardly called for when the dividends mount up from $87,000,000 to $197,000,000, in round numbers,—an increase of over 126 per cent. in gross, and of 100 per cent. on the basis of capital stock outstanding,—between 1897 and 1903. It is claimed, to be sure, that earnings were very small in 1897, but it is well to remember that this fact was not allowed to interfere to any great extent with the payment of dividends.

TABLE XVI. PASSENGERS AND EMPLOYEES.

Casualties per Million Train-miles.—Derailments.

Group.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	U.S.
Year.											
1891 . .	2.4	0.8	2.6	5.8	4.7	1.7	2.6	4.5	4.5	6.4	2.7
1892 . .	0.9	1.1	1.8	5.0	6.1	1.7	3.6	3.4	4.2	3.0	2.2
1893 . .	1.0	1.1	1.7	1.9	4.0	2.2	1.1	4.3	3.4	4.5	2.2
1894 . .	0.4	1.2	1.9	1.9	4.4	1.4	1.0	1.1	3.6	4.5	1.8
1895 . .	0.6	1.2	1.3	2.0	3.5	1.2	1.0	1.3	2.4	4.4	1.6
1896 . .	0.7	1.4	1.4	2.2	4.0	1.2	1.0	2.0	2.8	2.6	1.6
1897 . .	0.9	0.9	1.6	1.6	2.9	1.0	2.5	1.8	3.2	4.6	1.6
1898 . .	3.0	0.9	1.5	3.3	2.5	1.0	1.0	1.4	3.1	2.2	1.7
1899 . .	0.5	1.1	1.1	2.7	4.3	1.8	1.8	2.9	3.9	3.5	2.0
1900 . .	0.4	0.8	1.7	5.2	4.1	1.3	1.6	1.8	3.4	3.5	1.8
1901 . .	0.5	1.1	2.7	5.1	2.8	2.0	6.0	3.0	3.5	3.8	2.3
1902 . .	1.1	2.2	2.3	4.1	3.8	2.5	2.4	4.3	7.6	3.4	2.9
1903 . .	0.9	1.5	2.8	7.9	7.8	3.3	2.9	4.6	7.6	5.8	3.5

Table XVII exposes the point of greatest weakness in American railway service. As in the preceding table, the figures for total casualties are used in order to smooth out fluctuations due to exceptional cases, and thus disclose more clearly certain general tendencies. The tendencies here shown are even more marked in the case of employees taken separately. For instance, the number of employees killed in collisions in the United States in 1895 was 134, and in 1903 574,—an increase of 328 per cent. The figures in regard to injured were 1,008 in 1895, and 3,772 in 1903,—an increase of 274 per cent. Reduced to a train-mile basis, the increase in killed is still 236 per cent., and the increase in injured 192 per cent.

TABLE XVII. PASSENGERS AND EMPLOYEES.

Casualties per Million Train-miles.—Collisions.

Group.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	U.S.
Year.											
1891 . .	2.5	3.4	3.0	4.3	6.8	2.3	3.0	2.8	3.3	5.0	3.4
1892 . .	3.0	4.0	2.6	5.0	5.9	2.5	1.9	2.4	2.4	2.3	3.3
1893 . .	4.1	4.3	2.5	1.6	4.1	2.0	1.5	1.9	2.4	2.7	3.1
1894 . .	1.6	3.0	3.6	2.6	3.1	2.1	0.6	1.2	2.2	2.1	3.2
1895 . .	1.5	2.6	1.7	2.0	2.6	1.2	1.2	1.6	4.0	3.4	2.0
1896 . .	1.3	2.2	1.6	4.1	6.3	1.1	1.1	2.1	3.6	2.3	2.2
1897 . .	1.4	2.0	1.8	2.7	3.7	2.0	2.0	2.2	3.2	2.8	2.2
1898 . .	2.6	2.0	2.5	2.9	3.0	1.4	2.2	3.5	2.3	2.7	2.3
1899 . .	4.0	3.3	2.6	3.6	3.4	1.4	3.7	2.0	3.3	4.5	3.1
1900 . .	3.3	3.6	3.8	7.0	6.9	2.3	5.0	2.4	3.5	3.5	3.6
1901 . .	1.4	6.6	3.7	6.4	6.6	2.3	4.7	3.1	5.0	4.5	4.4
1902 . .	3.7	8.1	6.5	8.4	6.7	4.5	6.0	4.3	7.6	8.0	6.1
1903 . .	3.4	8.1	9.2	15.0	7.9	5.1	8.4	9.7	6.5	9.8	7.4

The above table shows that the increase in casualties from collisions for the whole country between 1895 and 1903 was 270 per cent., and ranged among the different groups from 127 per cent. in Group I to 650 per cent. in Group IV, which maintains the same bad record disclosed in the matter of derailments. By comparing this table with the following one in which density of traffic is measured in train-miles per mile of line, it will be seen that amount of traffic does not afford an explanation of this increased liability to collisions. An increase of 305 per cent. between 1898 and 1903 is observed in Group II, where traffic is densest, and 300 per cent. in Group X, where traffic is least dense.

TABLE XVIII.

DENSITY OF TRAFFIC IN THOUSANDS OF TRAIN-MILES PER MILE OF LINE.

Group.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	U.S.	U.K.	Can.
1891	7.3	9.9	6.1	3.3	3.6	3.9	2.8	3.1	2.8	3.0	3.6	16.0	3.1
1892	7.7	10.7	6.3	3.2	3.8	4.3	2.8	3.1	2.9	2.9	3.7	16.1	3.0
1893	8.1	10.6	6.5	3.3	3.6	4.3	2.9	3.5	2.9	2.9	3.8	15.6	2.9
1894	7.5	9.5	5.8	3.1	3.2	3.8	2.5	3.0	2.8	2.6	3.4	15.9	2.8
1895	7.0	9.5	5.7	3.2	3.2	3.4	2.3	2.8	2.8	2.5	3.3	16.0	2.5
1896	7.3	9.8	5.8	3.4	3.2	3.9	2.2	2.9	2.8	2.6	3.4	16.6	2.7
1897	7.1	9.6	5.4	3.4	3.3	3.7	2.2	2.9	3.0	2.4	3.3	17.2	2.7
1898	7.2	10.0	5.6	3.3	3.5	4.0	2.4	3.3	3.0	2.5	3.4	17.5	3.0
1899	7.2	9.8	5.8	3.3	3.6	4.0	2.4	3.2	3.0	2.7	3.4	18.2	2.9
1900	7.3	9.4	5.9	3.3	3.4	3.9	2.4	3.1	2.7	2.4	3.4	18.4	3.0
1901	6.9	9.3	6.0	3.2	3.6	3.9	2.6	3.2	2.8	2.6	3.4	18.1	2.9
1902	7.1	9.3	6.1	3.3	3.7	4.0	2.6	3.3	2.9	2.8	3.4	18.0	3.0
1903	7.4	9.3	6.2	3.4	3.8	4.1	2.9	3.2	2.8	2.9	3.5	18.6	3.2

The above table has a certain significance on its own account. It shows how much denser railway traffic is in the United Kingdom than in the United States and Canada. 18,600 train-miles per mile of line means that on the average 51 trains pass over each mile of line in the United Kingdom every twenty-four hours, Sundays included. It also shows that the density of traffic in the United States, measured in this way, has not been increasing, but has rather fallen off since the early nineties. This signifies that the growth of traffic, measured in train-miles and passenger-miles, has been distributed over longer lines and bunched in heavier trains, which would seem to indicate that the train despatcher's duties are no greater than before. But whether the fault is with the brain that issues orders or in the one that receives and executes them does not matter, so long as the results are the same.

The facts brought out in this array of statistics indicate that something is radically wrong with the methods of operating railroads practised in this country. The case against the roads is not so bad as it appears at first sight, yet there is apparently room for improvement in nearly every respect.

The record of collisions, always bad, has been growing steadily worse in spite of improvements in available devices for their prevention, which the experience of other countries has shown to be both effective and reasonably inexpensive. Neither can the old plea of poverty be any longer accepted in view of the growth in earnings and great increase in dividends in recent years.

The energies of railway managers should be directed toward checking this evil. A thorough overhauling of present railway practice in this country is imperatively demanded. The absolute block system must be installed where the density of traffic demands it, and the "train staff" or some equally efficient system on single track lines where the block system would not be practicable. In order to hasten progress in these matters, it might be well for Congress to pass an act for that purpose.